Molecular Manipulation in Electro-Spun Scaffold for Gene Delivery

Benjamin Chu, Stony Brook University, DMR-9984102

Laser light scattering and TEM were used to characterize plasmid DNA, first collapsed in a poor solvent mixture of 94% DMF and 6% 1XTE buffer with a volume contraction of ~10^3. Then, the collapsed DNA was encapsulated by using a tri-block copolymer of lactide (L) and ethylene glycol (E), as shown in Figure 1 with data listed in Table 1.

Table 1: Physicochemical properties of DNA & LEL

Plasmid DNA (7164 bp)	DNA in 1x TE buffer	DNA in 94% DMF + 6 % buffer	$L_{10}E_{78}L_{10}$ in 94% DMF + 6% buffer
M_w (10^6 g/mol)	4.81 ± 0.21	6.9 ± 0.6	0.18 ± .01
R_g (nm)	135 ± 6	15.2 ± 1.8	39 ± 2
R_h (nm)	87 ± 2	17.2 ± 2.0	44 ± 2

Electro-spinning of poly(lactide-glycolide) with encapsulated DNA in the same solvent mixture could form a nano-fibrous scaffold containing bioactive plasmid DNA, as shown in Figure 2.

The scaffold has the suitable morphology that will enable endogenous cells to migrate into it, adhere, proliferate, and initiate new matrix/osteoid production.

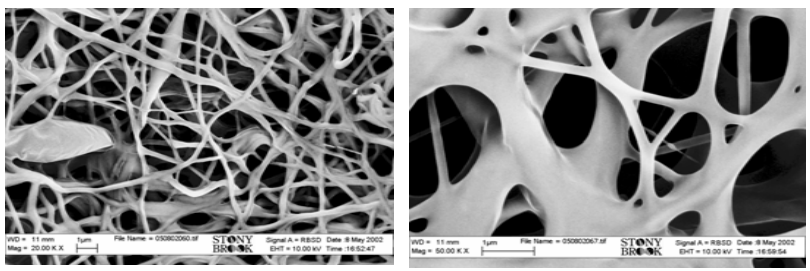

Fig. 2 SEM of DNA-Containing Biodegradable scaffold

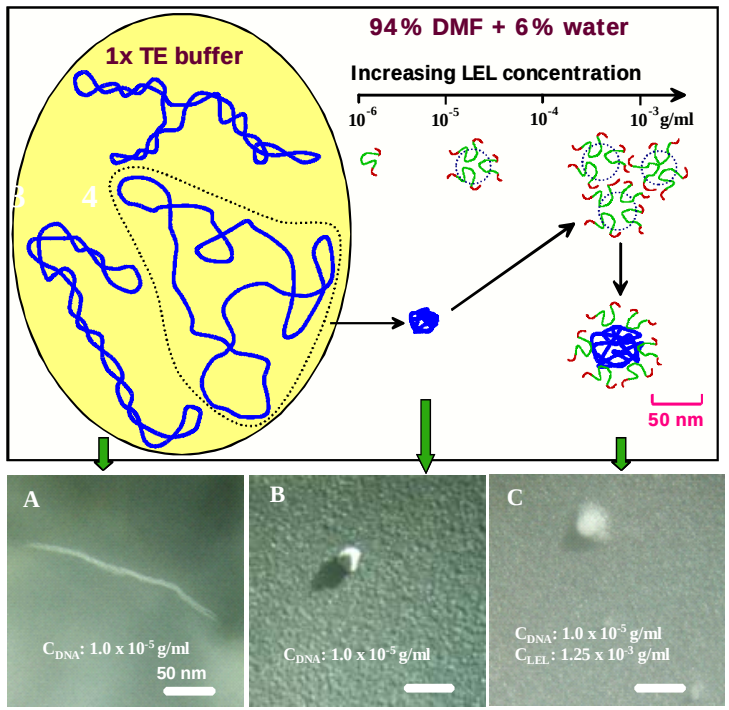

Fig.1 Collapse and Encapsulation of DNA.

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Education:

Under this grant, two students have completed their Ph.D. degrees: Both Dr. Tianbo Liu (Associate Physicist, Brookhaven National Laboratory) and Dr. Dehai Liang received the Presidential Award to Distinguished Doctoral Students, reserved for those with the highest achievements in the Graduate School at Stony Brook University.

Dr. Christian Burger, who came as a Feodor Lynen Fellow from the Max Planck Institute in Golm, is now working on problems related to polyelectrolyte-surfactant complexes, bio-mineralization, and modified Fullerene vesicles.

Outreach:

We plan to continue to take advantage of the REU program, the Simon Fellowships, and the Science Education Program, including the Intel (formerly Westinghouse) Prep Program for motivated undergraduate and high school students.

With supervision by interested graduate and post-doctoral students, BC had 8 high school students who became semifinalists in the Westinghouse/Intel competitions in recent years. For the 2000 Siemens/Westinghouse competition, one high school student entered the individual com-petition and two high school students entered the team competition from the BC group. Both the individual and the team of two students became the regional finalists, out of a total of six individuals and six teams in the six regions of the United States.

The picture below shows BC with collaborators, high-school, graduate, and post-doctoral students.